REVERSE STATISTICAL MULTIPLEXING TO ACHIEVE EFFICIENT DIGITAL PACKING WITH LINK PROTECTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to digital networks, and more particularly to a ring configured system for efficiently packing data while restoring service in the event of a failure.

2. Description of the Related Art

15

20

10

5

Synchronous Optical Network (SONET) configurations available commercially from Lucent Technologies, Inc., using for example, DDM-2000 equipment, can provide service using a ring configuration which permits a multiplicity of demultiplex sites, each feeding a customer location, and also provides protection switching for the SONET equipment to restore service in the event of a failure of one link in the optical network.

10

15

20

Unfortunately, this combination of features cannot be readily applied to service configurations using Asynchronous Transfer Mode (ATM) transmission of broadband signals, such as those using Internet Protocol (IP), without having to deploy extra units of digital bandwidth, many of which are not fully utilized. This situation constitutes an economic barrier to the hoped-for deployment of several ATM transmission systems that will provide greater speed for the download of digital data to Internet end customers. The additional equipment also increases system complexity and handling.

Therefore, a need exists for a multiplexing apparatus and method congruous with ATM transport networks in a SONET ring network that includes the capability of restoring service and maintaining transferred data in the event of a failure of one or more links in the SONET ring.

SUMMARY OF THE INVENTION

An asynchronous transfer mode network, in accordance with the present invention, includes a plurality of remote terminals remotely disposed relative to a central office.

10

15

20

The remote terminals are connected by a ring with two paths. The ring transfers signals thereon in opposite directions relative to each path. The central office feeds duplicate signals on each path. Each remote terminal includes a first multiplexer for routing signals transferred on the ring to and from an asynchronous feeder multiplexer. The asynchronous feeder multiplexer is adapted to route components of downstream signals on a first path of the ring to a destination and to replace the components of the signals on the first path with copies of components of signals running in an opposite direction on a second path of the ring such that at any location in the network both paths provide all signals.

Another asynchronous transfer mode network of the present invention includes a first path for connecting a plurality of remote terminal sites and for transferring asynchronous transfer mode signals in a first direction and a second path for connecting the plurality of remote terminal sites and for transferring asynchronous transfer mode signals in a second direction opposite the first direction. A central office is coupled to the first and

10

15

20

second paths for feeding duplicate asynchronous transfer mode signals downstream from the central office to the remote terminal sites and for receiving upstream asynchronous transfer mode cells from the remote terminal sites to compare upstream signals and to select a best available upstream signal. The remote terminal sites include a first multiplexer for routing signals transferred on the first and second paths to and from an asynchronous feeder multiplexer. The asynchronous feeder multiplexer is adapted to route components of downstream signals on the path to a destination and to replace the components of the signals on the first path with copies of components of signals running in an opposite direction on the second such that at any location in the network both paths provide all signals.

In alternate embodiments, the asynchronous feeder multiplexer may include protection logic adapted to compare signals received from the opposite directions on the two paths to select a signal to be output. The protection logic may select for the output that signal which remains after a loss of signal has been detected. The protection logic

10

15

20

selects, for the output signal, a signal having a best signal quality, e.g., the least number of bit errors. The signals received from opposite directions may include components and the protection logic may selectively choose or merge components of each output signal based on the components having a best signal quality. The network may include a synchronous optical network (SONET) with at least an STS-1 optical bandwidth. The network may include metallic channels in the two paths of the ring, with for example, a DS3 bandwidth.

A method for providing add/drop capability and link protection in an asynchronous network of the present invention includes providing an asynchronous transfer mode network having a plurality of remote terminals remotely disposed relative to a central office. The remote terminals are connected to a ring including two paths which transfer signals thereon in opposite directions relative to each path. Duplicate signals are fed downstream on each from the central office. The signals transferred on the two paths are routed to and from an asynchronous feeder multiplexer at each remote terminal. Components of downstream signals on a